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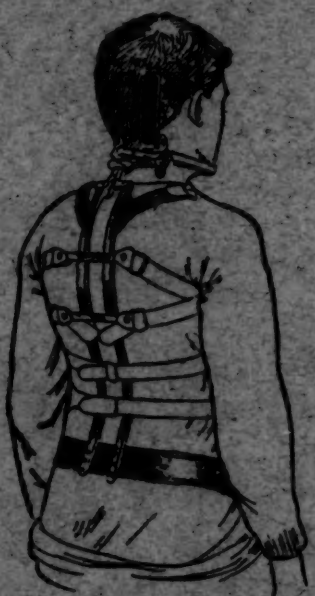

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The Journal of Orthopædic Surgery

# INJURIES TO THE SESAMOID BONES OF THE GREAT TOE

BY ALBERT H. FREIBERG, M. D. F. A. C. S., CINCINNATI, O.

*Read at the Annual Meeting of the American Orthopedic Association, at Toronto, June, 1920*

Since 1904, when Stieda (Beitr. z Klin. Chir. XLII, 1) published his article on this subject, quite a number of articles have appeared in which there has been discussed the significance of symptoms assigned to the region of the metatarso-phalangeal joint of the great toe on its inferior aspect. In these cases, the x-ray showed for the most part that the mesial or tibial sesamoid bone was divided by a transverse cleft, into two parts; now nearly of equal size, now of quite unequal proportions. On the other hand, other observations have been made corroborating those of Stieda to the effect that both of the sesamoid bones of the great toe are sometimes divided congenitally and that in this event we are likely to find the sesamoids of the other foot similarly divided. Most of the reports which are to be found in this connection are in substantial agreement in the character of the symptoms, but there is considerable variance in the writers' views as to their meaning. The absence of all reference to this subject in the various treatises and text books which I have consulted is so uniform that one is inclined to believe their authors in agreement with the ancient mystics who believed, according to Hyrtl (Lehrb. d. Anat. 20th Ed. 1889, p. 438) that the mesial sesamoid of the great toe was the one unbreakable, incombustible and indestructible bone of the body which remains in the earth after death as the germ from which the whole body is to be resurrected on the Day of Judgment. I have not endeavored to ascertain whether it is incombustible, but I am convinced that it is not unbreakable. Geist (Am. Journ. Orth. Surg. 1915) having examined 100 clinically normal feet, found congenital division present in 16. Since this

seemed to me an unusually large proportion, I requested Dr. Karl Little to examine a large number of x-ray plates of feet in the collection of the Cincinnati General Hospital, with this object in view. Over 1000 plates were examined in consecutive order and without reference to the reason for making them. To my surprise, he found only one plate in which a transverse division of the sesamoid was present; this concerned the mesial sesamoid only and the other foot was not examined. (Fig. 1.)

FIG. 1.

Gen. Hosp. Obs. A. 84—Man admitted for contusion of left foot and leg. Run over by coal wagon. Dismissed the same day. Sesamoid condition not noted at the time.

FIG. 2.

Gen. Hosp. B. 4401.—Man admitted as result of automobile accident. Wheel passed over foot. X-ray showed comminuted fracture of *lateral* (fibular) sesamoid of great toe. Dismissed five days later and not again heard from.

My interest having been aroused by two cases in which the inferior aspect of the first metatarsophalangeal joint was the seat of pain, in which the x-ray showed division of the mesial sesamoid and in which the nature of the condition had not been recognized by well trained surgeons, I have investigated my private case records with respect to injuries of this bone. As a result I conclude that the sesamoid bones of the great toe are not rarely the seat of traumatic damage and that they are subject to all of

the varieties of trauma which are common to their better known congener, the patella; moreover, that in a general sense the mechanism of their production is the same.

I have met with one case of luxation of the mesial sesamoid. The patient was a man of 50 who struck his toe against a chair when moving about his bedroom in the dark. There was marked local swelling and the sesamoid could be plainly felt on the inferior and mesial aspect of the joint. The patient brought an x-ray with him from another city; where the accident occurred. Unfortunately he was permitted to take it away and I am unable to produce it. The bone was removed under local anesthesia and the diagnosis confirmed.

I have seen several instances in which the line of fracture was of such character and direction that its traumatic nature would be universally acknowledged. In two instances there was comminution and in all of this group of cases, the history points to direct violence as the cause. This is analogous to the fractures of the patella where we find that the stellate, comminuted or oblique fractures are those which are produced either by direct violence or by comparatively slight direct violence against the patella with the quadriceps in strong contraction. (Fig. 2.)

These cases are however, not the ones to which the greatest interest attaches, but rather those in which the x-ray plate shows the division to be more or less transverse and, more especially in which the patient is unable to furnish a definite history of violence from without, nor for the most part, of sudden onset. I was led to make an investigation of the histories and x-rays found among my private cases chiefly through the experience which I had with an infantry officer during the war and just prior to my entering upon active military service. This man was 40 years old, a lawyer by profession, and had entered the service voluntarily. While still in training camp and after a long spell of duty in the training trench, he complained of pain on the inferior and mesial aspect of the right great toe joint. This not only produced a limp but interfered with walking so that he was compelled to report to the medical officer. No definite diagnosis was made; complete rest was ordered and in a few days he was believed to have recovered completely. The swelling and tenderness which had been present had entirely disappeared. Duty was resumed and

the pain and swelling promptly recurred. This cycle was gone through several times with the same result, without a definite diagnosis being made and with the final insinuation of exaggeration of symptoms, to say the least. When I was now consulted, I found distinct swelling on the mesial and inferior aspect of the first metatarsophalangeal joint with great tenderness on pressure over the mesial sesamoid. The other metatarsophalangeal joints were not tender. X-rays of both feet were made; on the right side the mesial sesamoid was found divided by a cleft slightly oblique. A small third fragment was seen on the outer side and apparently joined to the distal fragment by a slender bony pedicle; there appeared to be some evidence of new bone formation going on between the two large segments. In the left foot, the mesial sesamoid is of dumb-bell shape giving the impression either of having been divided and later united or, of having a thin place where fracture might conceivably take place with ease. I ordered mechanical protection, as later to be described, but am not informed as to the later course of this case. (Fig.3.)

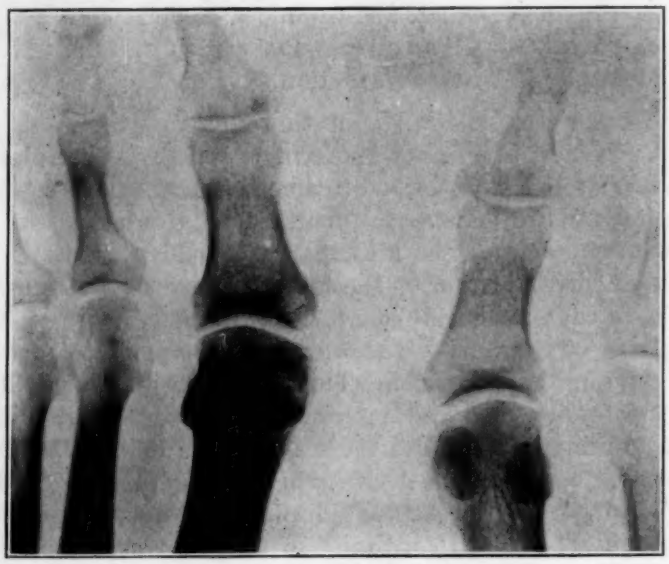

FIG 3.

No. 4653.—Infantry captain, 40 years old. No history of definite injury. Oblique division of mesial sesamoid. A third small fragment seen to outer side and connected to distal fragment by a pedicle. The mesial sesamoid of the symptomless foot is dumb bell shaped.

Aside from two cases in which the mesial sesamoid was fractured by direct violence and to which no special interest attaches in the present discussion, I have been able to find fourteen cases in my private records in which I feel that the symptoms which brought the patients to me were localized in the mesial sesamoid of the great toe and were to be ascribed to the division of this bone which was demonstrated by the x-ray. For the most part,

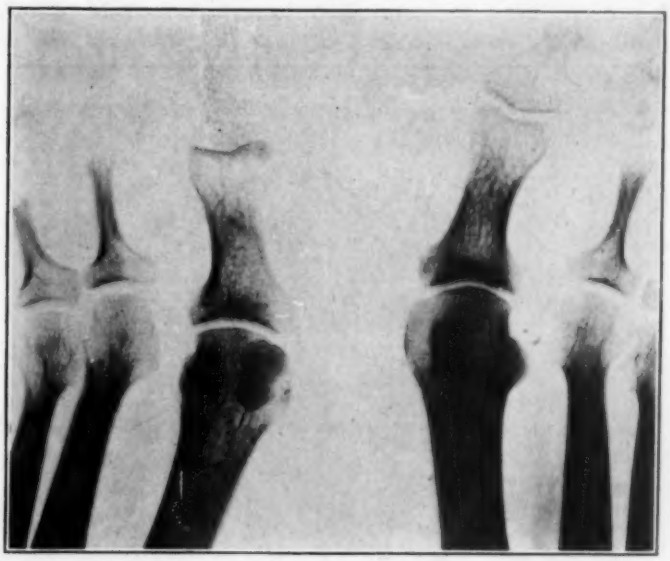

FIG. 4.

No. 4780.—Girl 20 years old. Seven years before felt sudden pain in ball of right great toe, while running. Felt like stone bruise, but has never entirely recovered. Plantar surface of joint is swollen, somewhat red and tender. This X-ray made one year after above note made; no further symptoms. Right mesial sesamoid shows healed fracture; left mesial sesamoid is dumbbell shaped.

there was no history of injury by violence and in no instance did the patient find it necessary to seek relief immediately after the injury. In nearly all there has been the experience of recurring cycles of pain in standing and walking, with some swelling of the great toe joint, subsiding after restricting activity and reappearing after it had been resumed for a time. The tenderness has been quite characteristic in its location over the mesial sesamoid. The X ray has been relied upon for the definite diagnosis and has

shown a cleft dividing the bone into a distal and proximal fragment, usually of unequal size.

Cases of this kind have been reported by various observers in no very small number but there is difference of opinion as to the significance of what has been seen in the x-ray plate and chiefly for the reason that it seems beyond question that division of the sesamoids occurs not infrequently as a congenital anomaly and without producing symptoms. I have observed one instance (No. 5498) in which there were no symptoms attributable to the sesa-

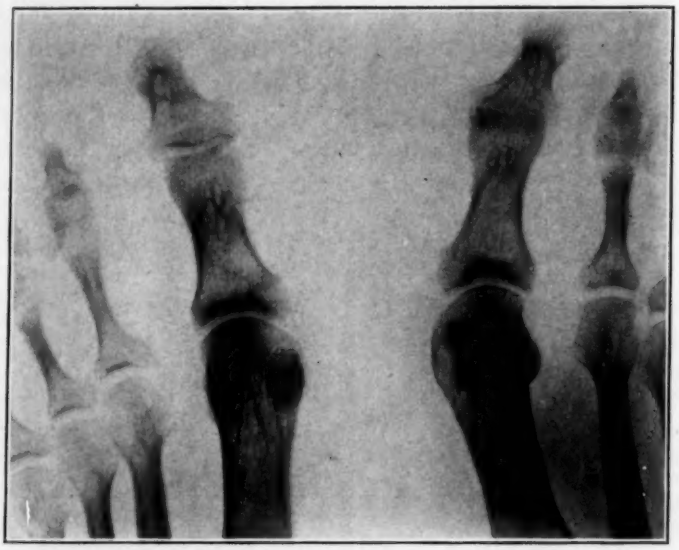

FIG. 5.

No. 4764.—Girl 17 years old. Got splinter in plantar surface of left great toe joint seven months before. Since then repeated attacks of pain and tenderness. Marked swelling and tenderness over mesial sesamoid. X-ray looks as if there had been fracture of sesamoid with subsequent union.

moids at all and in which the x-ray showed the mesial sesamoid of the left foot divided into two fragments and that of the right into four. On the other hand, in at least fourteen instances symptoms were to be ascribed so definitely to the region of the mesial sesamoid bone and in the most of them mechanical protection to this region resulted so promptly in relief, that the discussion of the precise pathological meaning of the x-ray appearances might seem purely academic. In view of the fact, however, that in sev-

eral instances the x ray gives evidence of the possibility of healing by bony union and because in the absence of local protection the symptoms have sometimes recurred repeatedly a different attitude of mind would seem justifiable. Stumme, (Fortschr. a, d. Geb. d. Roentgenstr. 1909, Vol. 13, p. 312) believed that he determined that true fracture existed in one case by the excision and careful examination of the fragments. He felt also that he had proved by experiment upon the cadaver that forcible dorsiflexion of the great toe with abduction could produce fracture of the mesial sesamoid. He believed also that it was possible to distinguish between traumatic division and congenital cleavage by the x ray appearance. The fracture shows sharp and pointed corners, whereas congenital cleavage is apt to show rounded ends; the ends of the fracture line show a break in the cortical substance and this

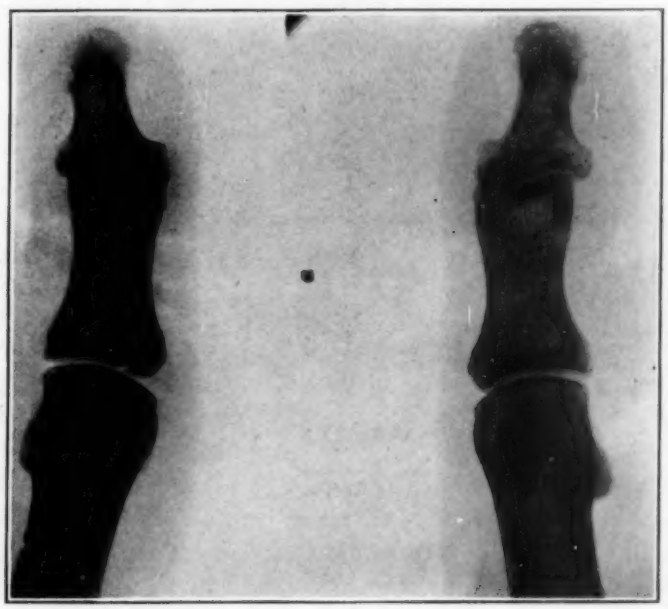

FIG. 6.

No. 5846.—Man 32 years old. Repeated attacks of pain and swelling in great toe of right foot. Very tender over mesial sesamoid and evident swelling. Stepped on round stone nearly two years ago and thinks trouble dates from this. Right mesial sesamoid shows transverse division into almost equal parts. On plate cleft is seen to be distinctly jagged. Relieved at once by mechanical treatment. Left foot normal.

is continued around in congenital cleavage; the fragments of the traumatic variety are of irregular shape whereas the congenital ones are prevailingly oval and finally the evidences of reparative activity are presumptive evidence of fracture. In a case reported by T. R. G. Orr (Annals of Surg. 1918, LXVII, p. 609) there was a history of two distinct injuries to the bone and a later x-ray

FIG. 7.

No. 3743.—Woman 33 years old. Pain on inner side of plantar surface of left great toe joint for about ten weeks. No recollection of injury. Pain was continuous at first but now dependent upon use. Mesial sesamoid shows oblique irregular line of division with appearance of repair. Lateral sesamoid shows a central thin spot. No record of right foot.

showed bony union to have taken place. I believe, therefore, that sufficient evidence exists to warrant the belief that some of these cases represent true fracture and that bony union may take place. It should therefore be striven for. In at least two of my cases, division of the mesial sesamoid in the symptomless foot and the character of the cleavage make it seem probable that I was dealing with a congenital anomaly; at the same time, the distinct localization of the pain and tenderness make it altogether likely that the cleft was the seat of traumatic damage and the treatment was effective in producing permanent relief.

In one instance, that of a girl of twelve years, I was consulted because of recurrent pain and tenderness which I ascribed to the region of the right mesial sesamoid; (No. 5858) the x ray showed that both sesamoids of this foot and the mesial sesamoid of the left foot were divided. I should say that these clefts corresponded to the congenital variety, if Stumme's distinctions are to be admitted; not only because of the fact that three of the four sesamoids are involved but also because the corners are somewhat rounded and the corticalis seems continuous around the whole periphery of each segment. In this case relief was at once afforded by the application of a felt pad immediately behind the tender spot; this was continued for a number of weeks until the local tenderness was quite gone. In this patient the longitudinal arches of the feet are very high and she is being given exercises

FIG. 8.

No. 4113.—Woman 26 years old. Direct injury to right foot two weeks before. Great tenderness over lateral sesamoid which was not suspected as seat of injury before X-ray was made. This shows longitudinal fracture of lateral sesamoid but also division transversely of mesial, apparently of congenital character. No X-ray of left foot made.

to strengthen the toe flexors. Thus far there has been no recurrence of pain although the case is still under observation.

The fact that there is a congenital division of the sesamoid instead of a traumatic one in no wise alters my feeling as to the mechanism by which the production of the symptom is to be explained. In the act of rising on the toes and with a degree of abduction of the great toe, the sesamoids and more especially the mesial, act as a fulcrum upon which the weight falls. According

FIG. 9.

No. 4609.—Man 22 years old. Came because he had been called in the draft, for service. No history of injury, but for the past six months has been having attacks of swelling pain and tenderness in right great toe joint after athletic exercise. Marked tenderness over mesial sesamoid and some swelling. X-ray shows divided mesial; cleft oblique and somewhat irregular. Left foot on separate plate, is normal. Pronounced unfit for immediate service. Further course unknown.

FIG. 10.

No. 3705.—Woman 31 years old. Injury to foot six months before. Recurring attacks of pain and swelling in right great toe joint. Movement in flexion is accompanied by distinct grating. Tenderness over mesial sesamoid. X-ray shows almost transverse cleft in proximal third of mesial, with jagged edges. No record of other foot.

to the extent to which the power of the long flexor has become weakened, as by the effect of shoe wearing, the stress upon the sesamoids in the short flexor becomes greater in this position. The sesamoid may thus become the seat of a cross breaking strain which may cause it to part into two divisions; or, in the event of a congenital cleft may result in damage to the fibres which connect the two segments. I should therefore regard the symptoms as of traumatic origin in this case also.

FIG. 11.

No. 5858.—Girl aged 11 years. No history of injury. Pain and tenderness over mesial sesamoid of right foot. No swelling. Both feet weak and pronated. X-ray shows both sesamoids of right foot divided; apparently congenital type. Left mesial sesamoid also divided. Relieved by mechanical protection.

In three of the cases observed there has been an appearance in the sesamoid as of new bone formation and some progress toward union of the fragments; in two cases, the mesial sesamoid of the symptomless foot has a dumbell shape, suggesting either that a fracture had healed or that the bone was congenitally thin at this point. In neither case was the patient able to remember having had symptoms which would furnish an explanation.

In none of my cases, save the one of luxation, was there operative intervention. The treatment consisted of the application of a thick pad of felt immediately posterior to the point of tenderness and its retention by means of adhesive plaster. This pad was replaced every few days until the tenderness was gone; an anterior heel or cleat of leather, ¼ to ⅜ inch thick and 1¼ to 1½ inch wide, was then inserted between the layers of the sole of the shoe just behind the metatarsophalangeal joints. At this time exercises were instituted for developing the flexor power of the toes.

FIG. 12.

No. 5498.—Girl 13 years old. Comes because of pain in region of anterior arch of left foot. Third metatarsophalangeal joint of left foot is tender and quite thickened. X-ray made for this reason. No symptoms attributable to sesamoids of either foot. Mesial of left foot divided transversely; that of right foot divided apparently into four parts. Lateral sesamoid of right foot shows nick at mesial border; shows in less degree on left foot also.

In none of my cases did I fail in this manner to bring about relief of the symptoms promptly. In the greater number of the cases I am able to speak of the relief as having endured. In several, however, the patients have passed from observation and they

have not been followed up. I feel however, that in the event of recurrence of symptoms I should have become informed of this.

I feel as if an apology were due for presenting a paper upon a subject so unimportant. At the same time, I also feel that by recognizing the meaning of these conditions I have been able to treat these patients more rationally. In one instance I have been able to save a man from no little humiliation and in a number of instances have been able to put an end to the cause of repeated interferences with physical activity and even vocational disability.

### Discussion

Dr. Twinch: I should like to ask the reader of the paper if he has seen enlarged sesamoids in these cases? Some two or three years ago an article in *Surgery, Gynocology and Obstetrics*, the author expressed his opinion that hallux valgus was caused by enlarged sesamoids and that the cure was the removal of these bones. Since reading the article referred to I have removed the sesamoids when operating for hallus valgus, and finished the operation by simply removing the hypertrophied bone on the inner side of the head of the metacarpals.

Dr. Sayre: One man that I saw had pain on flexing his toe. The sesamoid appeared normal but the proximal phalanx was dropped so low that on dorsiflexing his toe it struck the metatarsal head. I removed the superior surface of the metatarsal head, allowing the toe to slide up and so relieved the symptoms.

Dr. Freiberg (closing): It is often hard to determine whether or not there has been fracture or whether the condition is congenital, but I think there is often trauma, even in the congenital cases.

Dr. Hammond (closing): In reply to Dr. Twinch, the sesamoid does not seem to be enlarged. The patients had conservative treatment without relief and this led me to remove the sesamoid. I think Dr. Freiberg is right as to trauma being a cause of the condition because both the sesamoid and the metatarsal show erosion spots from pressure.

# THE JONES OPERATION FOR THE ANKYLOSIS OF SUBDELTOID BURSITIS

BY WALLACE BLANCHARD, M. D., F. A. C. S., CHICAGO

*Read at the Annual Meeting of the American Orthopedic Association, at Toronto, June, 1920*

Subdeltoid bursitis is one of the most common and at the same time the most frequently unrecognized of the shoulder injuries.

During the first month it is often difficult to make a diagnosis of bruising of the subdeltoid bursa and supraspinatus tendon and the patient frequently passes out of the hands of the attending surgeon before calcareous degeneration and shoulder joint fixation develop.

The following case has a typical history: A factory man, aged 42 years, had a slight fall and caught his weight on his hand. The pain that followed was severe, but the arm could be moved in all directions. The factory surgeons reported that no fracture or anything abnormal could be found by physical examination or seen in the radiogram.

They put the arm in fixation dressings for a month and when it was set free the patient still complained of severe pain and inability to use the arm. Thereupon the industrial insurance company declared the man to be a malingerer and no longer entitled to indemnity. For several months he remained in disgrace and without his rightful compensation.

When he came into my hands, firm adhesions had formed in the shoulder joint and there was strong resistance to motion beyond an arc of 15 degrees. The man was hard to handle because he was a giant in size and strength. Under an anaesthetic and following the method of General Sir Robert Jones the patient was held upon his back so that the scapula rested securely upon the table. The assistant's fist was placed in the axilla and against the head of the humerus to prevent a possible downward dislocation. The arm was moved firmly into abduction and rotated inward and outward and then pushed backward to its normal limit. Then finally the arm was given forcibly its full radius of movement. The breaking of the adhesions in the

shoulder joint sounded like the fracturing of bones. Two days later the man could reach as high above his head with one hand as with the other and declared himself cured. Jones warns against half-hearted attempts to break up the adhesions and also against the danger of increasing the amount of cicatricial tissue by injudicious passive movement early in the disease.

Fig. 1. Radiogram showing a lime salt deposit about the size of a split pea at the apex of the head of the humerus.

I have broken up the adhesions of subdeltoid bursitis upon the operating table without an anaesthetic in a number of cases. These patients had fixations ranging in duration from two months to two years but always got perfect and almost instantaneous relief.

This forceful method should not be used except when the painful fixation is caused by a sterile deposit of lime salts and after a careful examination has been made to exclude active dis-

ease and the other forms of painful disability of the arm. Brickner[1] has emphasized the sterility of the lime salts deposits with 200 cases of open operation for the relief of ankylosis of subdeltoid bursitis without finding a trace of infection of any kind.

The radiogram here presented, Fig. 1, shows a lime salt deposit about the size of a split pea on the apex of the head of the humerus.

In this case the patient sustained an injury of the shoulder that produced a fracture of the clavicle. The fracture united firmly with some displacement, and when the fixation dressings were removed a painful ankylosis of the shoulder joint remained which mystified the attending surgeon. Two months later the lime salt adhesion in the shoulder joint was broken up by the Jones method with instant relief of the painful fixation. The force required to break the adhesion in this case was greater than seemed warranted by the small extent of the lime salt deposit seen in the radiogram. The lime salt deposit was in an early formative stage and if the breaking up had been delayed a year, the deposit would have shown three or four times larger and several shades darker in the radiogram.

It is frequently noticed in ankylosis of the shoulder joint that the rather free mobility of the scapula imparts considerable movement to the arm even though the fixation of the head of the humerus may be quite complete. Bucholz[2] has reported a fracture of the humerus made in an attempt to forcibly break up the adhesions in a case of subdeltoid bursitis. It is conceivable that lime salts may accumulate around the head of the humerus till the adhesions may become stronger than the bones contributing to the shoulder joint, so that the humerus may fracture under force without the giving way of the articular adhesions. I never expect to see such a case, and if it does appear the radiogram will surely give a timely warning. It is safe to say that the Jones method of breaking up the adhesions in the fixed and painful shoulder of subdeltoid bursitis will be found to be uniformly successful in properly selected cases.

In cases which I believed would yield to moderate force, I have simplified the operation by dispensing with the assistant's

1. Brickner: Journal A. M. A., 1917, Vol. 59.
2. C. Herman Bucholz: Orth. Sec., A. M. A. Trans., 1917.

fist in the axilla and moving the arm forcibly backward to its normal limit and then swinging it around in its full radius of movement with the same satisfactory results. In occasionally using this shorter process I have followed a precedent established by the originator of the operation.

Nine years ago I saw Sir Robert Jones stand a British officer against a door frame and break up subdeltoid bursal adhesions that had existed for several years. The painful ankylosis was immediately relieved and the patient was cured so quickly that it seemed as if I had just witnessed a good turn of legerdemain.

### Discussion.

Dr. Truslow: I am interested in the question of lime deposits. I had a case in the winter, a young woman, on whom I operated and thought I had removed the deposit, but the X-ray showed about one-third left under the acromium process. The other side has become painful and the X-ray shows the same trouble there.

Dr. Osgood: I remember one case of lime salt deposit in an elderly gentleman. I did not feel inclined to give him an anesthetic and made a rather gloomy prognosis. Two months later the X-ray showed not a single trace of the deposit. The symptoms disappeared without any operation.

Dr. Rugh: I have had a similar experience to that of Dr. Osgood, but I used hot fomentations, twice a day, followed by massage, and the X ray showed disappearance of the exudate.

Dr. Freiberg: I don't think you can place reliance on that. I have seen a disappearance of these deposits without any fomentations at all, or any other form of treatment.

Dr. Sayre: It is quite possible that the lime salt deposit is there and you don't see it the first time. I have seen it appear within half an hour. It happened to be behind the head of the humerus and so was obscured by the shadow, and became visible when another X-ray was taken with the humerus rotated outward.

Dr. Blanchard (closing): The supraspinatus tendon is always involved in the lime salt deposit of subdeltoid bursitis. Dr. M. S. Henderson has reported the case of a farmer with subdeltoid ankylosis who fell from a ladder catching himself so that his body weight broke the shoulder joint adhesions and effected an immediate cure.

# OSTEOMYELITIS

BY DR. F. C. KIDNER

In civil practice, bone infection is usually of hematogenous origin, altho direct infection thru a wound of the soft parts, does occur. In military practice, bone infection of hematogenous origin does occur, but most of the cases are due to infection thru the skin. Blood infections invade and spread in bone, thru well-recognized anatomic channels, the blood vessels. Infection thru the skin is in no way dependent on anatomy. The two forms of osteomyelitis, are therefore, essentially different, at least till the very late stages.

Acute osteomyelitis of blood origin, will affect the area of bone supplied by the whole arterial system, as in the fulminating, destructive type in childhood, or it will affect larger or smaller areas of medulla and cortex, in accordance with the size of the arterial branch, by which the infectious material enters. Thus we may have an acute osteomyelitis, involving a whole bone shaft, or merely a localized infected area, as in the Brodie's abscess. Only secondarily, does hematogenous osteomyelitis spread by direct extension, to surrounding areas of bone. It is therefore, fairly safe to predict, after the determination of the first area of infection, what the ultimate limits will be.

In infections occurring from without, the anatomy of the blood vessels is of little importance. The spread of the infection depends on the areas of bone immediately soiled, on the extent of the fissures and cracks formed, and on the devitalization of medulla and cortex, thru the destruction of blood supply.

In both types of bone infection, the amount of damage depends on the relation between the virulence of the infecting organism, and the inherent resistance of bone to infection. This resistance is greater when the blood supply is good, and less when it is interefered with. Therefore, comparatively non-virulent organisms may cause wide-spread and persistent infection when the blood supply is wholly or largely destroyed, while virulent organisms may cause only sharply limited and mild infections, if the blood supply is good. Thus, a simple staphylococcus may bring about the destruction of the whole shaft of a tibia when it enters thru, and blocks the arterial supply of the bone. On the other hand,

a virulent streptococcus, even with a gas bacillus may cause only a localized process, if it enters from without, and does not interfere greatly with blood supply.

Bone infection spreads rapidly and widely thru the blood stream. It spreads slowly or not at all, by extension and contact if drainage can be established. If drainage is inefficient, there comes into play, the factor of pressure or tension. If pus is under tension in any part of bone, there is a pressure necrosis of the adjacent tissues, which break down in spite of nature's attempts at walling-off. This breaking down constantly exposes new tissue to re-infection and the spread of the disease is rapid. This is not true where proper drainage exists. Early, thorough drainage of all acute bone infections is, therefore absolutely essential.

It was the recognition of this fact that led to and established the popularity of the Carrel-Dakin method, and later, debridement, in war surgery. Wide exposure of infected bone, as advocated by Carrel, was basically correct, but the pendulum swung too far. It was forgotten that even soiled bone, if it has a blood supply, maintains power of resistance to the spread of infection. Therefore, the advocates of bone debridement agreed that all soiled bone must be removed. The result was often pitiable. Three or more inches of soiled bone was removed from a shaft and prompt healing was often obtained, but at a tremendous price as regards resulting function. Wide opening of soft parts down to, and around, infected and damaged bone, was necessary but removal of all such bone was unwise. Many surgeons adopted the proper midcourse and preserved all fragments which had any semblance of attachment to soft parts, and then left the wounds wide open. In their cases, it made little difference whether drainage was kept up by Carrel-Dakin tubes and solution, or by any other means, which prevented blocking back, of the discharge. The results were uniformly the best possible for the case at hand. It was often startling to see fragments of bone, which at the first operation had appeared to be almost certainly dead, re-acquire a nutritive blood supply and take up the formation of new bone, even tho they lost a part of their substance by ultimate sequestration. These war lessons should then, give us much help in the treatment of bone infection, in civil life.

In hematogenous infections, drainage should be immediate and open up the whole area of the infected blood supply. X-ray,

as Hammond says, will not show the limits of the infected area. Direct observation, thru a cortical incision, made sufficiently large, is the only method of determining the extent of the disease. In the compound fractures of civil life, thorough opening of the whole field damaged by the trauma, with wide drainage, is the only safe procedure if virulent infection is suspected. Secondary closure of compound fractures, which prove themselves to be sterile, is a simple matter. Infection of bone, appearing after a wound is closed, is apt to be a serious matter.

Theoretically, acute osteomyelitis should never develop into chronic. If drainage could be made sufficiently thorough and sufficiently early, there would be no opportunity for bone necrosis and spread of the infection. Unfortunately, however, in hematogenous infections, these two desiderata are rarely obtainable. We can only hope to approach them more and more closely by earlier diagnosis; as Simmons has insisted, and by more thorough operation at the hands of more skilful men. In the compound infected fracture, occurring in civil life, the lessons of the war should teach us that there is very little excuse for the establishment of chronic osteomyelitis. Civil conditions, except under unusual circumstances, allow early complete operation, and operation in competent hands should establish efficient drainage and get ahead of the infection, as skilful thorough operation does, in sepsis of the hand, foot or other soft part. I am convinced that the principles of skilful and conservative debridement, should be applied to all compound fractures. Not the mass debridement which was so popular among many army surgeons and so destructive of function, but the careful, accurate surgical removal of devitalized soft tissue from every nook and cranny of the wound thru an incision large enough to allow inspection of every crevice, accompanied by removal of fragments of bone which are soiled and totally detached from soft parts. All attached fragments should be cleansed and replaced, as nearly as possible, in their normal position. All periosteum should be carefully preserved, because, in spite of all discussion, it does regenerate bone, and has a very active power of resistance to the destructive effects of infection. After such a complete operation, if there is any possibility that septic material has been left behind, the wound should be left wide open and drained in any efficient manner, such as Carrel-Dakin, rubber tissue, or other method, which allows flushing of all parts of the wound. It is far

better to leave such a wound wide open for a few days till culture proves it to be aseptic, than to close it and have sepsis develop later. Following such a preventive operation, the mechanical treatment of the fracture is of greatest importance. Absolute rest in good alignment, is a sine qua non. Such treatment will invariably lead to prompt closure of the wound and prevent osteomyelitis. In a recent case, a farmer was seen nine hours after a fall from a tree into richly fertilized garden soil. He had sustained a compound, comminuted fracture of the upper end of the ulna, internal condyle of the humerus, and a dislocation of the head of the radius. The local doctor had merely washed the fragments and replaced them. Immediate operation was done thru a wide incision, which excised the edges of the skin-wound, and with the aid of repeatedly changed knife and forceps, the torn, damaged and soiled, soft parts were all dissected away. There were no free fragments but many loose ones. These were cleaned mechanically with rongeurs, scissors and knife. The wound was left partly open over its deepest parts, and the fracture immobilized in a position which direct inspection proved to be good. There was secondary healing in ten days, no resulting bone infection, and an elbow function of 80% of normal, in spite of the fact that the patient was fifty-seven years of age, and that culture from operation showed streptococci.

When chronic osteomyelitis is established, the problems of treatment become most complicated. Extension of the process from the original focus has occurred, either by gradually extending necrosis and re-infection, or thru the vascular medulla. How far this extension has gone, is, I believe, beyond our present methods of examination to determine. The X-ray shows only sclerosis or actual destruction. It does not show any new areas, which are more or less actively infected. The extent of periosteal thickening is not co-incident with the extent of the infection; that is, deep infection may extend far beyond the periosteal re-action. The X-ray does not always distinguish between sequestra and vital fragments. It is extremely difficult to tell what the virulence of the infecting organism may be. Operation, under such conditions, must be a more or less blind procedure, as well as a dangerous one. Mechanically, it is very hard to reach and remove all infected areas, or it may, as so often happened in our war cases, lead to an intense virulent general flare-up, which endangers the patient's life. These facts are undoubtedly true of the average chronic osteomyelitis,

during the early stages; that is, during its first eighteen months. Virulent infection may lie dormant in bone for very long periods, in civil practice, as in war cases. A recent case will illustrate this: A child, who had had a septic, compound fracture of the humerus, was operated on, for non-union eighteen months after all wounds had healed. The ends of the sclerosed bones were simply split and interlocked; no metal nor other foreign body being left in. Six hours after the operation, the child had a temperature of 105. Next day the site of operation was tensely swollen, the child was delirious and the temperature was 106. The wound was opened wide and cultures from the ends of the bones showed a streptococcus.

What then, are we to do with established osteomyelitis? Two methods of procedure were advocated overseas, and are still advocated in the army services. The first is radical operation, with the removal of all infected bone as soon as acute symptoms have subsided, followed by sterilization of the wide-open cavity by one of the methods of irrigation. The second is the more conservative procedure of watchful waiting over long periods of time, supplemented by the occasional incision of abscesses, with the gentle removal of frank sequestra.

Theoretically, the first method, carried out at the earliest possible date, is the ideal one. In many cases, at the hands of the most experienced and skilful surgeons it has been successful, and has been followed by complete, and probably permanent healing. In the hands of the average man, I am convinced it has done much harm, because of its inherent difficulties. Practically, it is not always possible to distinguish and remove all infected bone, in widespread, active osteomyelitis, without, at the same time, sacrificing much good bone and infecting areas previously unaffected. The technique too, of maintaining sterility after the radical operation is very difficult. In an experience of two years, first with the British, and later in American army hospitals, I have become persuaded that conservatism is the wise course in the vast majority of routine cases. Most cases of infected fractures will, under proper splinting and rest reduce themselves to a low-grade localized osteomyelitis with firm union. Such cases ultimately reach a stage where function is possible, in spite of one or more easily cared-for sinuses. To be sure, flare-ups frequently occur, but these can al-

most always be controlled by a few days' rest with the application of heat, or by the simple opening of an abscess.

Careful observation of parallel cases, treated by the two methods, first at the Military Orthopedic Hospital in London, and later at the U. S. A. G. H. No. 36, at Detroit, have not shown any marked superiority of results, in the cases treated by the radical method, at the end of one to two years. Most of the radically operated cases, have recurred and the patients have had to be subjected to multiple operations, as in the conservative method.

It was my practice at General Hospital No. 36, during the spring and summer when I was in charge of the orthopaedic service, to treat osteomyelitis by the most rigidly conservative methods, allowing radical operation only when the enthusiasm of my co-workers became uncontrollable. The result was that when the patients were transferred to another hospital in July, there was very little disabling or generally harmful osteomyelitis among them. Since then, it has been my good fortune to see many of these cases when on leave in Detroit. All of them have had from one to five operations for the cure of their osteomyelitis, done, so far as I can gather, on the radical plan. All of them have been made more or less sick and been confined to bed for prolonged periods. None of them is any better than he was eight or ten months ago under conservatism.

So strong a plea for conservatism sounds pretty hopeless, and would not be worth making, if there were nothing to offer as a way out. This, I believe, there is, and it lies in the one word, patience. The vast majority of chronic osteomyelitis will, given time, become quiescent and sharply localized. That is, the infecting organism will become practically non-pathogenic and the infected focus will become thoroughly walled-off and delimited. It will reach a stage where infected can be recognized in contrast to healthy bone, by the X-ray. How long this will take, no man can tell, nor will external physical signs determine. The only test is exploratory operation. By this is meant an operation which enters and explores the infected bone, but makes no attempt at radical removal. If such an operation is followed by no re-action, then we may be reasonably sure that attempts at radical removal may be safely made, with only the mechanical difficulties to cope with, and with prospect of permanent cure. The type of operation must

depend on the size, shape and position of the infected area. In the shafts of the long bones, if any healthy bone is left in the thickness of the shaft, the lateral method of excision, advocated by Chutro, is the best, as it provides better muscle and soft part masses to fill the gap. Removal of the whole shaft, for the length of the infected area, is sometimes necessary. If the periosteum is preserved, this can be done, with the hope of regeneration even in adults, and it at least offers opportunity for later grafting.

To sum up then: the treatment of osteomyelitis is, in fractures where infection may enter thru the skin, prevention by thorough, immediate cleansing, and drainage; second, conservatism of the most thorough sort, for very long periods; third, radical operation of the most careful and thorough sort, when infection is completely quiescent and the extent of the diseased bone can be predicted.

I regret that I have had no opportunity to use the method of Wayne Babcock published in the J. A. M. A. May 8, 1920. His radical operation under zinc chloride sterilization and staining of the infected tissues, sounds very attractive, but very difficult.

# NERVE LESIONS FOLLOWING COMMON TYPES OF BACK STRAIN AND THEIR RELATION TO PROGNOSIS OF DISABILITY.

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*Read before the San Francisco Neurological Society, June 4, 1920.*

The forms of back strain which are illustrated by the following case reports are such as are frequently met with in industrial and private practice. Their exact pathology is often very obscure. In consequence of this obscurity faulty diagnosis and prognosis is apt to be made.

Many of these cases are satisfactorily dealt with by prompt reference to an orthopedic surgeon but many are disabled for a much longer time than the orthopedist expects them to be. In such, a careful neurological examination will frequently shed more light on the cause of prolonged disability and thereby serve to contribute to a more accurate prognosis.

The cases reported in this paper are illustrations particularly of low back strains due to lifting heavy objects while the spine is strongly flexed and strains due to sudden falls or mis-steps while the patient is off guard and which result in symptoms and signs referable to the various branches of the lumbar-sacral plexus. One case is an exception in that the effects of the trauma were at a higher level. (See Case III.)

Owing to the many structures which can be involved in a sudden strain of the back the pathology may be multiple in its manifestations and such complications as arthritis may still further confuse the clinical picture.

The main purpose of this paper is to demonstrate that common types of back strain frequently result in something more complex and more disabling than a simple strain of the sacro-iliac or lumbar-sacral joint.

## CASE REPORTS.

*Case I.*—A young laboring man in July, 1919, while lifting some heavy sacks from the ground strained the lower back. An X-ray examination showed an impingement of the transverse process of the fifth lumbar vertebra upon the iliac crest on the right

side. He complained greatly of pain in the distribution of the sciatic, obturator and genito-crural nerves of the right side. A plaster jacket was applied with the spine in the hyper-extended position but this gave no relief and the transverse process was removed in March, 1920. The pain in the obturator and crural regions had gradually subsided but the sciatic pain has persisted and he has developed symptoms of irritation of the superior gluteal nerve and the external cutaneous nerves of the right thigh which have persisted for several months. Examination shows hyperesthesia in the distribution of the superior gluteal nerve and external cutaneous nerve and the pain in the sciatic nerve has been so severe so to require alcohol injection. After a year from the date of the original injury he is incapacitated for any work.

*Case 2.*—A professional golf player of thirty years fell down a ladder and struck the right buttock. This occurred on November 18, 1918. He has since complained of pain in the distribution of the superior gluteal nerve, especially when standing or bending forward. Massage, manipulation and a low back brace have failed to relieve him. The X-ray showed no pathology. An examination of his spine shows on May 1, 1920, a diminished lumbar curve with rigidity of the lumbar muscles when the spine is flexed forward or laterally.

The tonsils are infected. The pain in the superior gluteal nerve continues and after eighteen months he is incapacitated for work. In this case an arthritis in conjunction with a slight plexus lesion must be considered.

*Case 3.*—A man now forty years of age wrenched his back while climbing a telephone pole in October, 1913. Immediately after he had symptoms of obstruction of the bowels and a laparotomy was done. The cause of the obstruction cannot be learned. He recovered and enlisted in the navy and after the war was discharged in good condition. In May, 1919, while lifting a piece of timber he again strained his back and experienced severe pain in the lumbar region with numbness of the legs, frequent urination and obstinate constipation. A neurological examination seven months later showed weakness and loss of tone in the muscles of both legs and thighs, exaggerated tendon reflexes, double ankle clonus and Babinski and a gait which was a combination of ataxia and spasticity. Sensation was diminished in the lower extremities but particularly on the left side. He was not seen again but

recently it has been learned that he was operated on for a suspected cord tumor and the report of the surgeon is as follows: "Extensive thickening of the dura from the level of the 4th to the 6th dorsal vertebrae and extending around and along the nerve roots. Pathological diagnosis is 'pachymeningitis chronic.'" There was no laboratory evidence of syphilis in this case. This patient evidently had extensive extra-medullary and intra-medullary hemorrhage following a comparatively slight form of trauma, (back strain), without any bony lesion of spine and the exudate had become firmly organized.

*Case 4*—A man of thirty-two on December 1, 1916, fell down an incline while running and struck the right side of his back. He continued to work for a month. Then one morning just after getting out of bed he noticed a severe pain in the right leg along the entire distribution of the sciatic and was unable to walk. An examination three months later showed diminished sensibility to light touch along the anterior crural nerve of the left side with hyperesthesia to painful stimuli, patellar reflexes equal but exaggerated, Achilles reflex very active on the left but absent on the right. The X-ray showed some time before this a fracture of the transverse process of the right fifth lumbar and he had been in a plaster jacket for several months. A month later the neurological examination revealed the same signs as before and two years after the accident he was still complaining of pain in the right sciatic nerve. He is at work but has continued to require a pelvic belt.

*Case 5.*—A young carpenter on February 19, 1917, was pinned under a heavy piece of timber and in trying to extricate himself he twisted his body violently. Immediately he suffered severe pain in the right inferior gluteal nerve and later in the right sciatic nerve. X-ray showed fracture of the transverse process of the right fifth lumbar. He was put in a plaster jacket and his pain was entirely relieved. A week after the accident the neurological examination was negative. Two months later he was complaining of pain in the right sacro-iliac region and downward across the right buttock and a neurological examination showed a definite loss of tone with some atrophy in the gluteus maximus and weakness of the tensor fasciae femoris; Achilles reflexes absent on both sides, plantar reflexes very active. The fractured transverse process was then removed. A few weeks later he was doing light work but continued to have pain in the back and right leg. This case was then put

up to the State Commission and it was considered that some of the man's pain was due to scar tissue in the soft parts and some of it to a neurosis. A year ago, over two years after the accident, he was still doing only half time work. Whether a neurotic element entered in to this case or not it is apparent from the above findings that the man sustained a severe plexus injury with interruption of the fibres going to the inferior gluteal nerve and either an intra-neural or extra-neural lesion of the sciatic.

*Case 6.*—A man of thirty years slipped on a wet floor and fell backward striking the left side of his body. He got to his feet readily and went to work. About two weeks later he began to have dull pain down the back of his left leg from the hip to the ankle. Adhesive strapping, hot baths, massage, etc., failed to relieve him. A neurological examination showed acute pain in the left sacro-iliac on pressure over it with cold sensation in the left leg; partial loss of sensation in the distribution of the small sciatic, gluteal, anterior crural and obturator branches of the plexus; Achilles reflex absent on the left. X-ray showed cloudiness of left sacro-iliac joint. Wasserman test positive. The man recovered entirely without any special treatment in about a year.

*Case 7.*—In March, 1917, this man, while lifting about two hundred pounds from the ground had a sudden pain in the middle of sacral region and was unable to move his legs. Later the pain radiated down the right leg posteriorly to the knee. X-ray showed congenital defect in the fusion of the spinous processes of the sacrum, a fracture of the sacrum through its middle portion at the level of the third spinous process and a twisting of sacrum between the ilia. Symptoms were partly relieved by manipulation and a plaster jacket. Neurological examination showed hyperesthesia on the back of the left heel with a more active Achilles reflex and patellar reflex on the left side. There were no objective signs in the right leg although this was the side on which the patient complained of pain. A month later the same signs were present. The patient has since been lost track of. It is interesting to note that the objective signs were on the opposite side from the subjective symptoms.

*Case 8.*—A deck hand of fifty-five years strained his back and right hip while wheeling a barrow load of sugar on February 6, 1917. X-ray showed congenital failure of union of the spinous processes of the sacrum and an impingement of the transverse process

of the right fifth lumbar upon the ilium. Neurological examination a month later showed a marked degree of hyperesthesia to all stimuli in the distribution of the right sciatic and gluteal nerves; Achilles reflex absent on both sides, patellar and other reflexes normal. His symptoms were relieved by a plaster jacket but two months later he began to complain of pain in the right sacro-iliac joint radiating upward to the angle of the right scapula with hyperesthesia to light stimuli in this area. The former neurological signs were still present. Three months later the patient was at work.

*Case 9.*—An athletic carpenter of forty-five years while lifting a heavy object from the ground in August, 1919, strained the back and abdominal muscles so badly that he went to bed for two weeks. Then tried to work but had to give up after two days. X-ray and spinal puncture were negative. A sacro-iliac belt worn high relieved him somewhat. Examination of the teeth showed one abscess. The heart was found deficient in its myocardium and there was a mild degree of secondary anaemia. Examination of the spine six months after the injury showed only a slight flattening of the normal lumbar lordosis with limited motion of the 7th and 8th dorsal vertebrae. When the patient did no work of any kind he was free from symptoms but as soon as he attempted even light work he would experience pain in the lower dorsal region and would become very fatigued and nervous, perspire freely and then be afraid to attempt work again. He was sent to the writer as a case of traumatic neurosis. Under psycho-therapy and treatment of his anaemia he showed much improvement in general health as well as in self confidence but on going back to light work he again had a recurrence of distressing pain in the lower dorsal spine. Later in the course of treatment and examination by the faradic current it was noticed that the muscles at the left of the dorso-lumbar spine did not respond as well as those on the right side and that those of the right side were in a state of spasm when the patient was in the upright posture. The same was true of the response to the galvanic current. The complaint of pain after effort was always located at the same point, about the level of the seventh dorsal. The patient appeared sincere, eager to return to work and his compensation was not sufficient to keep him out of debt, but in view of past experience of recurrence of symptoms he was afraid to attempt his regular occupation. Neurological examination negative in all other. In this case we are probably dealing

with strained soft parts, e. g., ligaments and possibly partially torn muscle and nerve fibres in a small area of the dorsal region, causing a weakness of the paraspinal muscles at this level. Until conditions are normal in these parts the patient cannot be expected to take up arduous work and in the face of the physical signs he should not be classified as a neurotic.

## COMMENT.

In commenting on the cases reported the writer wishes to call attention to the signs that were present in all except the second case of actual lesion of one or more branches of the lumbar-sacral plexus. The form of lesion cannot be demonstrated or proved but that either an intra-neural or extra-neural lesion was present is shown by such signs as persistent pain in spite of immobilization of the spine, sensory losses or disturbances, loss of muscle tone, isolated muscle weakness and absent Achilles reflexes. In the third patient there were signs of involvement of the spinal cord and this was proved by operation and pathological section to be the result of extensive subdural hemorrhage, also extra-dural.

Attention is called to the chronicity of symptoms in the majority of these patients and the long period of incapacity for work. In seven cases the average period of industrial disability was fourteen months; in two of these seven the period was two years, in one case twelve months, in another twenty months, in one six months and in another three months. One patient is permanently disabled.

# News Notes

The address of the chairman, Dr. Roland Hammond, before the Orthopedic Section at New Orleans, appears in the July 24 number of the Journal A. M. A. Dr. Hammond's title was "The Relation of Orthopedic to Industrial Surgery."

Ex-King Manuel has been elected an honorary member of the British Orthopaedic Association. King Manuel was largely influential in the establishment and maintenance of the curative workshops in the Orthopaedic Centers during the war.

The Cameron prize of the University of Edinburgh has been awarded to Sir Robert Jones in recognition of the highly important advances he has made in Orthopaedics and his many valuable contributions to the literature of the subject during the past five years. One of the conditions attached to the prize is that the recipient shall give a lecture or course of lectures in the university. The prize was founded in 1878 by the late Dr. A. R. Cameron, of Richmond, New South Wales. It is of the value of about 150 pounds, and may be awarded annually to a person who within the previous five years, has made important and valuable additions to practical therapeutics. The first recipient was Pasteur, the second Lister. The prize has not been awarded since 1915, when it was given to the late Sir Lauder Brunton.—*British Medical Journal.*

The Board of Governors of the American Hospital in London entertained Dr. Charles H. Mayo at dinner on July 6. The Earl of Reading, Sir W. Arbuthnot Lane, Mr. A. J. Balfour, Mr. Davis and Dr. Mayo were the speakers.

## MEDICAL AND SURGICAL HISTORY OF THE WORLD WAR

Among the important work under way in the office of the Surgeon-General of the Army is the preparation of the medical-surgical history of the World War. Col. Charles Lynch, M. C., is in charge of this work, and is assisted by Colonels Brooks, Siler, Moncrief, Wolf, Oliver and Major Kramer of the Surgeon-General's staff.

The history will include an account of the work done during the war in a great many branches of modern scientific medicine and surgery. Subjects to be presented and medical officers who will present such subjects are set out in the following:

Administration, Western Front, Lieut-Col. Louis C. Duncan.
Administration, United States, Lieut-Col. Fielding H. Garrison.
Narratives, Col. Bailey K. Ashford.
Sanitation, Col. W. P. Chamberlain.
Sanitation, Western Front, Col. Haven Emerson.
Internal Medicine, Gen. W. S. Thayer.
Surgery, Gen. John M. T. Finney.
Neurology, Col. Thomas W. Salmon.
Oto-Rhinology, Lieut-Col. Joseph R. McKimon.
Statistics, Maj. Albert G. Love.
Pathology, Col. William H. Welch.
Hospitals, Lieut Col. Casey A. Wood.
Communicable Diseases, Col. Hans Zinsser.
Gunshot Wounds, Col. George E. Brewer.
Aviation, Col. Thomas R. Boggs.
Gas Defense, Col. H. L. Gilchrist.
Reconstruction, Col. Frank Billings.
Ophthalmology, Col. George E. deSchweinitz.

It is expected that the history will contain about fifteen volumes, and according to present tentative plans the respective volumes will cover the following titles:

I. Introduction.
II. Administration—United States.
III. Administration—Western Front.
IV. Statistics. Mathematician Interpretation of Data (Anthropometry).
V. Sanitation in the United States, Including Possessions.
VI. Camps and Cantonments.
VII. Hospitals.
VIII. General Medicine.
IX. Neurology.
X. Surgery.
XI. Gunshot Wounds.
XII. Pathology.
XIII. Physical Reconstruction.
XIV. Air Service.
XV. Chemical Warfare.

—*Jour. A. M. A., July 24.*

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Prepared by Dr. J. E. M. Thomson, Lincoln, Nebraska.

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# Current Orthopaedic Literature

CONSERVATIVE TREATMENT OF SARCOMA OF THE LONG BONES. Estor and Aimes. *Revue d'Orthopedie*, May, 1920, 193.

The question of amputation or disarticulation in cases of sarcoma of the long bones has usually not been open to discussion. Recently, however, due to the fact that many patients refuse radical treatment, surgeons have turned to more conservative intervention. In view of the good results which often followed such conservative treatment the discussion was opened by Gangolphe, Jaboulay, and Mickulicz in a series of publications, regarding the wisdom of amputation in all cases.

The evolution of the conservative treatment may be divided into three periods.

In the first period, about 1870-1880, the choice was between amputation and disarticulation, no other treatment was considered. Disarticulation seemed to be generally preferred to amputation.

In the second period, under the influence of Nelaton who insisted on the benign character of some of these growths, resection of the tumor was done in some selected cases by Verneuil, Terrier, and Schwartz. This procedure was opposed by Ollier, who condemned resection on the ground that the limb was usually useless afterward, and maintained that the surgeon who removed the most tissue was ultimately the most conservative. In 1882 Heurtaux resected the upper third of the humerus for what he believed to be tuberculosis. The lesions proved to be a round-cell sarcoma but the patient recovered without recurrence. This was the first instance of resection of a malignant tumor of long bone.

Third period. Gangolphe did his first case of deliberate resection for a presumably malignant sarcoma of a long bone in March, 1902, and has advocated the same procedure in cases where the tumor is well encapsulated.

It is due to the Lyonnaise school, with Gangolphe, Jaboulay, Polloson, Bevard, Cavaillon, and Alamartine, that surgeons have turned more to the conservative treatment.

The essential points in the teaching of this school are:

1. Histologic examination does not always fix with certainty the degree of malignancy of a sarcoma. Certain forms which are considered histologically as benign are capable of evolving into marked malignancy. Quite frequently a benign tumor contains a mixture of cells some of which are of malignant type and the exploratory osteotomy does not happen to strike any of these malignant cells. It may be said then that bone tumors are not benign or malignant according to their histologic nature, but they are potentially benign or malignant. The error of the surgeon has been, up to the present, a desire to establish a correlation between the histologic nature and the clinical evolution of osteosarcomata.

2. Macroscopic examination shows that a sarcoma is generally circumscribed and does not infiltrate into the surrounding tissue as a carcinoma does. In the encapsuled sarcoma there is a partial enucleation particularly if it develops in a region rich in connective tissue. Even if there be no capsule the borders of the sarcoma are distinct and always recognizable. In the medullary cavity if examination is made 5 or 6 cm. from the macroscopic limit of the tumor it is exceptional to find neoplastic elements. The epiphyseal cartilage line acts as an efficient barrier to the growth of an osteosarcoma.

3. Many patients are frightened away by the proposal of radical amputation in the early stages of bone tumors and do not return to the surgeon until too late. On the other hand if a conservative operation is suggested in the same early stage the patient will usually submit.

4. The functional result obtained by saving a hand in cases of sarcoma of the humerus is of utmost importance. After resection, the arm may be supported by a prosthetic apparatus and the hand retained in all its usefulness.

5. Resection of malignant tumors from other parts of the body is done continually and there is no reason why the results from resection in the limbs should be any worse than those from the same procedure in the various organs of the body. Statistics compiled by Gross in Philadelphia show that bone tumors invade the soft parts in only 12 to 66 per cent of the cases, depending on the type and that sarcomatous adenopathies occur in only 7.6 to 8.33 per cent. Moreover, the adenopathies are in many cases purely inflammatory and disappear after the tumor has been removed.

6. Statistics concerning local recurrence and metastases following disarticulation or amputation are not brilliant. Of seven cases followed by Koenig after disarticulation, one died two days later, one after a year, four died from metastases in one to three years, one case followed only six months. Borck followed thirty-six; twenty-two died the first year, two the second, one the fourth, and one the fifth year; of the remaining ten, six died of other disease and only four survive. Ten other series are given in the text of the article, all showing similar figures.

As to the results of conservative operation Kocher in 1906 reported fifty-three cases of various forms of osteosarcoma that had survived three years or more. Of these twenty-two had had resection and thirty-one amputation or disarticulation. Chirpaz studied twenty-seven cases which had survived from eight to ten years, all of which were either resections or enucleations.

The authors give in this paper their results in 138 cases: Humerus thirty, radius twenty-two, ulna twelve, femur thirty-six, tibia twenty-seven, fibula eleven, all of which were treated by conservative operation. The majority of these sarcomata were of the giant cell type, many of the spindle cell and round cell type, and most all other types were represented by one or more cases. Two were removed by simple excision, twenty-nine by currettage and 107 by resection.

Cases suitable for simple excision are very rare. One of the two was a man of 40 with a tumor the size of an orange, weakly adherent to the diaphysis at the lower end of the femur. The other was an adult man with an angio myxosarcoma on the great trochanter the size of a man's head. He had a recurrence two years after excision.

Curettage gave definite cures in about 40 per cent, two came to resection and four to amputation later. The most favorable in location were those in the femur and the most favorable type, the giant cell sarcoma.

The conservative operation par excellence for sarcoma of the long bones is resection. The results are good on the whole. Often it is necessary to do an almost total resection of a humerus, saving only the distal articular portion. Of the femur 25 or even 35 cm. have been resected. Complementary bone grafts are of course required in such cases.

Resections of the fibula have given the poorest results of any of the long bones, probably because more advanced cases have been attempted in that location. Here also the giant cell tumor has proved the most favorable type. Functional results of resections are generally good. The arm defect can be overcome by a prosthetic apparatus so that the hand may be almost normally useful.

Indications for the three types of conservative operations:

1. Simple excision of the tumor only when it has a pedicle and is not otherwise firmly attached.

2. Curettage is generally avoided because it is an incomplete operation, there is danger of causing diffusion of the sarcoma and it leaves a cavity which is easily infected. It may be done for giant cell tumors which have developed slowly as benign growths, or in case a patient refuses all other intervention, or in early growths which are very limited and well encapsuled, or in cases to be followed by Coley's serum.

3. Resection is indicated in cases of giant cell, spindle cell (pure or mixed), tumors of recent development, and those which are hard or limited by a resistant shell. Round cell sarcomas, those which are soft, ulcerated or infected and those of very rapid growth require radical operation. Resection is the operation of choice for the upper limbs, for even a flail shoulder, upper arm or elbow with preservation of the hand is to be preferred to radical amputation. For the lower limbs the functional results are probably not as good after resection as after amputation, everything considered. The leg will usually be shorter, there may be a persistent pseudo-arthrosis and it may be better to amputate and provide an artificial leg. This is especially true of the femur. Below the knee a bone graft may bridge the defect caused by resection and in some instances a fibula has been known to take on the function of weight bearing in place of the tibia. *—Dr. William Arthur Clark.*

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THE TRIPOD METHOD OF WALKING WITH CRUTCHES. By Robt. W. Lovett, M. D., Boston.

Complete paralysis of both lower extremities is not a bar to some form of ambulatory activity. This has been demonstrated in infantile paralysis, and the same generalization can be extended to any flaccid paralysis resulting from fracture of the spine or gunshot wounds of the spinal cord. As the latter class of cases has been called to our notice by the war, a consideration of how these patients may be taught to walk is one object of this paper.

The two muscles most necessary to maintain the erect position are the quadriceps extensor femoris and the gluteus maximus.

In aiding patients to walk, with such a distribution of paralysis, if the knees are kept from flexing by simple splints, the loss of the gluteus maximus can be compensated for by a peculiar method of using the crutches for what may be called "tripod" walking. If the crutches are placed apart and slanted well forward at their lower ends, they form the two anterior points of a tripod, while the third and posterior part of the tripod is formed by the body of the patient inclined frward at its upper part, with the feet well behind. The apex of the tripod thus comes at the shoulder level of the patient, his body and legs forming the posterior support of the tripod, and the crutches the two anterior supports. Such a position is stable because (a) the base of support is a large triangle bounded by the three points of support of the tripod, and (b) the body is stable in the over-extended position because hyperextension of the hips is checked by the "Y" ligament of Bigelow, and, with the knees stiffened by braces, the center of gravity falls in front of the hip joints and keeps them extended and firm. A paralysed patient with no power below the waist can stand unsupported easily in this position, if there are no contraction deformities in hip, knee or ankle.

The patient must next be taught confidence in this position. If he has been long confined to his bed or chair, he will have lost his sense of upright equilibrium which must be dealt with by itself and restored by repeated practice in standing on crutches with support near at hand, or by standing with both hands resting on the foot rail of the bed. When he has acquired the sense of balance to have self confidence, he should begin progression. This is accomplished by hitching one crutch a few inches forward, then the other crutch, and then in cases of complete flaccid paralysis, jerking the feet forward together a few inches by a body movement, bearing down with the hands on a crutch bar and sliding the feet over the floor. If any degree of power remains in the iliopsoas muscles, which is often the case when the gluteus maximus and all muscles below it are paralyzed, the feet can be more easily advanced one at a time, only those patients affected very severely having to slide along with both feet together. Most patients without any power in the hip flexors are able to accomplish this advancing one foot at a time by a twisting of the body.

For holding the knees extended the Thomas caliper splint is used. Two uprights, one outside and one inside of the leg, pass from the shoe to just below the gluteal fold. They are shaped to the leg, and at the bottom each is bent to a right angle. The bent parts of the upright slip into a tube in the heel of the shoe. At the top the uprights are fastened to a posterior, flat, curved band passing just below the gluteal fold, and a fenestrated knee cap of leather holds the knee extended. The splints can be joined at the knees for greater comfort in sitting, but the joint must be provided with an automatic drop catch which locks when the knee is extended. The use of a pelvic band on the braces rests on no anatomic or mechanical basis and is never necessary.

If abdominal weakness is present, a cloth corset is advisable to support the abdomen and give greater steadiness.

In flaccid paralysis of the lower extremities it is a fact that any patient of average intelligence, with one good arm and one arm good enough to hold a crutch, can be made to walk, provided deformities of the hip, knee and ankle are not present, or have been corrected.—*Leo C. Donnelly, Detroit.*

THE ORTHOPEDIC TREATMENT OF A FEW REMARKABLE INJURIES AND DISEASES OF THE BATTLEFIELD. Dr. Carl Deutschlander. Archiv f. Orthopædische u. Unfall Chirurgie. XVII Band, 3 Heft 10. January 1920.

The scope and significance of the orthopedic treatment of injuries and diseases of joints, muscles, tendons and the other tissues of the extremities has fully been recognized and demonstrated in the recent war by the surgeons of all belligerent nations. This article gives additional proof of the importance of applying orthopedic principles in the care of various injuries and diseases, especially in fractures of the femur, amputations, flatfoot and "rheumatic" affections which have come under observation of the author in the field hospitals.

Fracture of the femur:

Reviewing the various methods of treatment of these fractures, the conclusion is reached that plaster of Paris, applied with skill and technical correctness, was the most efficient means to keep the corrected position of the reduced fracture, to immobilise the limb and to relieve pain during the transportation of the patient. The objections to the use of plaster of Paris are discussed, and it is mentioned that the plaster splint has been the method of choice with only few exceptions, such as severe infection of the wound, lack of material and time for the correct application of the splint. Under these conditions only have metal splints been utilized.

Amputations: Conservatism was the rule. After eliminating all sources of infection and combatting all its dangers, the object in all amputation cases was to create a stump which would give to the patient a functionally useful extremity with or without an artificial substitute. Precautions were taken against leaving too short a bone stump, against retraction and shrinkage of the soft tissues and their contracture and against needless severance of muscular attachments. The lower extremities were supplied with temporary prosthesis as early as three weeks after the amputation. Crutches were largely discarded and early mobilisation of joints instituted.

Flatfoot: Most cases of flatfoot developed in city dwellers. It may be regarded as a sequence of "city culture": lack of exercise, sedentary occupations, poor shoeing, and hard inelastic street pavement.

The method of treatment consisted in: rest, proper exercise and massage. More advanced cases received also baking in improvised apparatuses, gradual correction of the foot by means of adhesive strapping and bandaging. The arch support was, with only rare exceptions, entirely dispensed with.

"Rheumatic" diseases of the extremities: Under this heading are discussed: myositis, neuritis, neuralgia and the arthritides. Their treatment consisted mainly of the proper application of physical measures: heat, massage and graduated exercises.

By this early application of the orthopedic principles, most excellent results were obtained in reducing disability and in minimizing the time for functional after treatment.—*A. Gottlieb*, San Francisco, Calif.

CONDITIONS THAT SIMULATE TUBERCULOUS DISEASE OF HIP. R. B. Wade, M. B. C. L. M. Sgd. *Medical Journal of Australia*, January 1920.

Difficulties that arise in the recognition of tuberculous hip joint disease are found only in the early stages.

Conditions simulating tuberculosis of the hip are changes in the periarticular tissues and in the joint itself. Of these there are—

Periarticular

1. Changes in the psoas sheath, which by reason of its passage over the joint will cause alterations in function, especially limitation of motion in certain directions.

2. During acute stage of infantile paralysis, may cause confusion by tenderness of affected muscles in this region.

3. Lesions of bone to which are attached muscles that control movement of hip joint. This is seen in tuberculous lesions of ischium or great trochanter.

Among the lesions of joint from which diagnosis must be made are—

1. Attenuated sepsis with delayed or modified symptoms.

2. Synovial inflammation of rheumatic nature.

3. Sprain fracture of adolescence. Trauma or simple coxa vara known as osteochondritis juvenalis.

4. Memory of organic hip joint trouble, seen in hysteria.

The outstanding points of tuberculous hip joint disease are—

1. History of previous injury.

2. Limp, due to flexion of thigh in order to take weight on balls and toes, thus lessening jar of walking.

3. Night starts are not often seen until late.

4. Pain referred to knee is not always found.

Examination reveals in supine position—

1. Flexion thigh with lordosis of spine when legs are straightened.

2. Flattening of lumbar curve when well leg is flexed on abdomen.

3. Limitation of motion in every direction, due to muscular tightening or guard action. Elicited by bending knee and flexing hip to right angle. Circumducted movements are limited in every direction.

4. Deviation to one side or the other, most often adducted.

5. Von Pirquet's reaction is found early. When positive without gross tuberculous lesions it may be assumed to be tuberculosis of the hip. If pain and limitation of motion in all directions is elicited, sure diagnosis can be made.

Among the pitfalls are—

1. Inflammation of psoas sheath, from
   (a) Abscess of Potts' disease
   (b) Appendicitis (rare)
   (c) Acute septic infection of psoas sheath.
   (e) Iliac glands
   Here flexion is seen without limitation of motion in all directions.

2. Tuberculous affections of ischium or great trochanter; cause limitation of flexion and rotation respectively.

3. Acute rheumatic infections are accompanied by high temperature and symptoms; and quiet down with short period of rest and salicylates.

4. Osteochondritis juvenalis or Perthes disease is extremely difficult, in early stages, to differentiate from tuberculosis of the hip. It is a chronic inflammation of the cartilage of the upper epiphysis of the neck of the femur, resulting in formation of coxa vara. These patients at no time show positive von Pirquet, and after a few months at rest, good movement is secured.

5. Coxa Vara, of rachitic origin, has no limitation of motion, being chiefly affected in abduction. An X-ray examination will clinch diagnosis.

6. Traumatic coxa vara results from strain or twist or green-stick fracture of neck of femur. Symptoms often simulate tuberculous disease of hip if untreated with coxa vara.

7. Septic infection of joint has early accompanying abscess with distinguishing pyogenic organisms in the pus. Also there is often early formation of bony sequestrum.

8. Hysterical hip can be determined by ruling out other troubles and by aid of x-ray and negative von Pirquet reaction.—*Dr. J. E. M. Thomson.*

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Report on Joint Mobilization With or Without Inter-Position. Beitr. z. Klin. Chir. Vol. 117. No. 3 1919.

Under certain general pre-suppositions a new joint may form just as well without as with inter-position of soft tissues, such as hernial sac, pig's bladder, etc., which offer a material that becomes absorbed too quickly to be of importance in the formation of a new joint. The question of inter-position is consequently of minor importance in arthoplasty. The splendid results obtained by Payer and others, are not due to fascia inter-position but to excellent technic. The only draw back in the technic without inter position is the hemmorrage which may lead to organization and stiffening of the joint.

In regard to the technic, the author polishes the end of the bone with burr and reamer. Drainage is procured by glass drain. Steinmann extension is used for twenty four to forty eight hours after operation. Passive motion is begun on the fifth to seventh day.

Report on 16 cases with 20 operations: Fat fascia inter-position 3 cases; autoplastic fat 1 case; fresh hernial sac inter-position 3 cases, preserved sac inter-position 1 case; preserved amnion 4 cases; no inter-position, polishing method 8 cases.

Joints operated on: Ankle 2 cases, knee five cases; hip 2 cases; fingers and wrist 4 cases; elbow 3 cases; jaw 2 cases.

Results. Ankle: One fat inter-position, one preserved hernial sac, one fresh hernial sac, gave doubtful results. Knee: Amnion 2 cases, preserved hernia sac 2 cases, polishing method 1 case, all results apparently alike. Hip: Fascia flap 1 case, polishing method (no inter-position) 1 case. Both results alike. Wrist: Polishing method (no inter-position) 2 cases, fascia 1 case, fresh sac 1 case. Sac inter-position failure. Others alike and fair. Elbow: Polishing method 3 cases, result good in all cases.

The author feels that the no inter-position method is equal in value to the method of soft tissue inter-position.—*A. Steindler, Iowa City, Iowa.*

SUGGESTIONS FOR THE TREATMENT OF FRACTURES OF THE RADIUS AND ULNA OF THE MIDDLE THIRD. Charles H. Lemon, M. D., Milwaukee, Wisconsin. *Wisconsin Medical Journal*, 1920, Vol. xviii, No. 2.

Among the author's reasons for discussing this subject are the facts that (1) the modern text books do not intelligently treat fractures of the middle third of the forearm; (2) that, next to fractures of the hip-joint, these are the most difficult fractures to handle; (3) that they are very frequent in children between the ages of three and twelve; (4) that severe deformities are frequently seen after the usual treatment of these fractures by the application of anterior-posterior splints, either in pronation or midway between pronation and supination with the thumb up.

The forearm of a child is usually plump, the bones are small and the muscles in a developing stage, very active and bearing to each other the relation of two to three as between the extensors and supinators on the one hand and the flexors and pronators on the other. With these potential anatomical possibilities, a breaking of the bones of the middle third means a loss of balance, because the flexors immediately become the bow-string, tightening day by day, and produce mathematically certain shortening by flexion on a line drawn from the palm to the elbow.

It is an elementary principle in the treatment of fractures of long bones that in order to overcome overriding or bowing, the joints of either extremity of the long bone involved must be fixed by whatever apparatus is used for flexion. It becomes obvious that in fractures of the middle third of the forearm, not only the hand and wrist should be fixed, but also the elbow joint and at least the lower third of the humerus, the latter being used for extension.

The teaching of text books, that in the position midway between pronation and supination the radius and ulna are at their widest point from each other, is incorrect according to the writer's observation. Further, in that position it is impossible to determine whether the bones are apposed at the point of fracture, no matter how much extension and counter-extension is used.

Having in mind the difficulty of determining the opposition of the fragments in the semi-prone position, the neutralizing of the one-third greater pull of the flexor and pronator group, and being assured that the relative position of the bones as to distance from each other is greater than or equal to that in the semi-prone position, it has been the practice of the author to treat all these fractures invariably in the supine position. Plaster-of-paris is applied in the form of a circular cast from the knuckles to the middle third of the humerus, the plaster being reinforced at the point of fracture to twice the thickness of the rest of the cast. As the cast hardens the arm is extended on a flat table and the hand and elbow brought in contact with its surface, thus producing over-correction of the fragments and extension, and further equalizing the loss that will occur in the circumference of the arm, due to its shrinking as the swelling caused by the fracture gradually disappears.

During the first five days, while the swelling is at its height, coaptative splints should be used, the point of fracture being doubly padded to give correction. Due to the fact that many of these fractures are subperiosteal or green-stick, they are readily reducible.—*J. E. M. Thomson, Lincoln, Nebr.*

A Simple Clamp for Making Balkan Frames of Iron Pipe. By George T. Johnson, M. D., Terre Haute, Ind. *Journal American Medical Association*, May 1, 1920, Vol. 74, No. 18.

These clamps can be quickly made by any blacksmith, from material in general use. Each plant consists of an iron plate made of ⅛-inch sheet iron and two U-bolts. Four holes are drilled in the plate to admit the free ends of the U-bolts. The dimensions given are suitable for use with ½-inch pipe.

A joint made with these pipes will not slip under a great load. They will likewise fasten the upright pipes firmly to the ordinary iron bed. If it is desired to make the frame independent of the bed, crutch rubbers serve admirably on the lower ends of the upright pipes and prevent any possible damage to the floor.—*Leo C. Donnelly, Detroit.*

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Osteomalacia, Is It a Rare or Rather Common Disease? By W. H. Dieffenbach, M. D. *Medical Record*, June 12, 1920.

From his experience the writer believes that a great many of the lesions of osteomalacia escape unnoticed until they become chronic. Very often the lesion is first diagnosed when spontaneous fractures occur. He believes that the disease is not an uncommon one, but is simply not recognized as a rule.

Aside from the Roentgen diagnosis which is typical and easily disclosed, there are sufficient clinical manifestations to diagnose the lesion in its early stages. These are the characteristic short unsteady gait, with bended back, the indefinite pains referred to different articulations, the excess of earthy phosphates in the urine, the frequency of the white lines of Sargent, white line occurring when skin is firmly stroked with a hard object such as finger-nail, caused by contraction of small blood vessels, and as the disease continues the diminution in height due to atrophy of bone or bending of the femur or other long bones. Osteomalacia simulates rheumatism and arthritic conditions and should be carefully excluded in these conditions.

The etiology, judging from the endemics in Central Europe points to undernutrition or improper nutrition with deficiency of lime, phosphorus and vitamines. Suprarenal, parathyroid, and gonad deficiencies are also noted in this lesion. Whether they are reflexly due to the above nutritional defects or are primary in character, remains to be determined.

Treatment by means of rest, actinotherapy, diet and endocrine products, especially in conditions not too far advanced, will be effective. There is hope for improvement in these patients if the basic cause is removed or ameliorated. —*Mark Cohn, M. D.*